

## NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

### NUTRIENT MANAGEMENT

(Ac.)

CODE 590

#### DEFINITION

Managing the amount, source, placement, form and timing of the application of plant nutrients and soil amendments.

#### PURPOSE

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To protect air quality by reducing nitrogen and/or particulate emissions to the atmosphere.
- To maintain or improve the physical, chemical and biological condition of soil.

#### CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

#### CRITERIA

##### General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with policy requirements of the Natural Resources Conservation Service (NRCS) General Manual Title 450, Part 401.03 (Technical Guides,

Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS South Dakota Technical Guide (SDTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.

Persons who review or approve plans for nutrient management shall be certified through any certification program acceptable to NRCS within the state.

Plans for nutrient management that are elements of a more comprehensive conservation plan shall recognize other requirements of the conservation plan and be compatible with its other requirements.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Realistic yield goals shall be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soil, cropping systems, and soil and manure/organic by-products tests.

For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Plans for nutrient management shall specify the source, amount, timing and method of application of nutrients on each field to achieve realistic production goals, while minimizing

Conservation practice standards are reviewed periodically and updated if needed. The current version of this standard is posted on our website at [www.sd.nrcs.usda.gov](http://www.sd.nrcs.usda.gov) or may be obtained at your local Natural Resources Conservation Service.

nitrogen and/or phosphorus movement to surface and/or ground waters.

Erosion, runoff and water management controls shall be installed, as needed, on fields that receive nutrients.

### **Soil Sampling and Laboratory Analysis**

**(Testing).** Nutrient planning shall be based on current soil test results developed in accordance with Land Grant University guidance or industry practice if recognized by the Land Grant University. Current soil tests are those that are no older than five years.

Soil samples shall be collected and prepared according to the Land Grant University guidance or standard industry practice. Soil test analyses shall be performed by laboratories that are accepted in one or more of the following programs:

- State Certified Programs, or
- The North American Proficiency Testing Program (Soil Science Society of America), or
- Laboratories whose tests are accepted by the Land Grant University in the state in which the tests will be used.

Soil testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient plan. Request analyses pertinent to monitoring or amending the annual nutrient budget, e.g. pH, electrical conductivity (EC), soil organic matter, nitrogen, phosphorus and potassium.

**Plant Tissue Testing.** Tissue sampling and testing, where used, shall be done in accordance with Land Grant University standards or recommendations.

**Nutrient Application Rates.** Soil amendments shall be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients.

Recommended nutrient application rates shall be based on Land Grant University recommendations (and/or industry practice when recognized by the university) that consider current soil test results, realistic yield goals and management capabilities. If the Land Grant University does not provide

specific recommendations, application shall be based on realistic yield goals and associated plant nutrient uptake rates.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance:

- Nitrogen Application - Planned nitrogen application rates shall match the recommended rates as closely as possible, except when manure or other organic by-products are a source of nutrients. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.
- Phosphorus Application - Planned phosphorus application rates shall match the recommended rates as closely as possible, except when manure or other organic by-products are source of nutrients. When manure or other organic by-products are a source of nutrients, see "Additional Criteria" below.
- Potassium Application - Excess potassium shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages. When forage quality is an issue associated with excess potassium application, state standards shall be used to set forage quality guidelines.
- Other Plant Nutrients - The planned rates of application of other nutrients shall be consistent with Land Grant University guidance or industry practice if recognized by the Land Grant University in the state.
- Starter Fertilizers - Starter fertilizers containing nitrogen, phosphorus and potassium may be applied in accordance with Land Grant University recommendations, or industry practice if recognized by the Land Grant University within the state. When starter fertilizers are used, they shall be included in the nutrient budget.

**Nutrient Application Timing.** Timing and method of nutrient application (particularly nitrogen) shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping

system limitations, weather and climatic conditions, and field accessibility.

**Nutrient Application Methods.** Nutrients shall not be applied to frozen, snow-covered, or saturated soil if the potential risk for runoff exists.

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449).

**Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source**

Nutrient values of manure and organic by-products (excluding sewage sludge) shall be determined prior to land application based on laboratory analysis, acceptable "book values" recognized by the NRCS and/or the Land Grant University, or historic records for the operation, if they accurately estimate the nutrient content of the material. Book values recognized by NRCS may be found in the Agricultural Waste Management Field Handbook, Chapter 4 - Agricultural Waste Characteristics.

**Nutrient Application Rates.** The application rate (in/hr) for material applied through irrigation shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.

The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following guidance:

- Nitrogen Application - When the plan is being implemented on a phosphorus standard, manure or other organic by-products shall be applied at rates consistent with the phosphorus standard. In such situations, an additional nitrogen application, from non-organic sources, may be required to supply the recommended amounts of nitrogen.
- Manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass.
- Phosphorus Application - When manure or other organic by-products are used, the planned rates of phosphorus application

shall be consistent with any one of the following options:

- Phosphorus Index (PI) Rating. Nitrogen based manure application on Low or Medium Risk Sites, phosphorus based or no manure application on High and Very High Risk Sites.\*\*
- Soil Phosphorus Threshold Values. Nitrogen based manure application on sites on which the soil test phosphorus levels are below the threshold values. Phosphorus based or no manure application on sites on which soil phosphorus levels equal or exceed threshold values.\*\*
- Soil Test. Nitrogen based manure application on sites on which there is a soil test recommendation to apply phosphorus. Phosphorus based or no manure application on sites on which there is no soil test recommendation to apply phosphorus.\*\*
- \*\*Acceptable phosphorus based manure application rates shall be determined as a function of soil test recommendation or estimated phosphorus removal in harvested plant biomass. Guidance for developing these acceptable rates is found in the NRCS General Manual, Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy), and the National Agronomy Manual, Section 503 (to be developed).

A single application of phosphorus applied as manure may be made at a rate equal to the recommended phosphorus application or estimated phosphorus removal in harvested plant biomass for the crop rotation or multiple years in the crop sequence. When such applications are made, the application rate shall:

- not exceed the recommended nitrogen application rate during the year of application, or
- not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when

there is no recommended nitrogen application.

- not be made on sites considered vulnerable to offsite phosphorus transport unless appropriate conservation practices, best management practices or management activities are used to reduce the vulnerability.

**Field Risk Assessment.** When animal manures or other organic by-products are applied, a field-specific assessment of the potential for phosphorus transport from the field shall be completed. This assessment may be done using the Phosphorus Index or other recognized assessment tool. In such cases, plans shall include:

- a record of the assessment rating for each field or sub-field, and
- information about conservation practices and management activities that can reduce the potential for phosphorus movement from the site.

When such assessments are done, the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

**Heavy Metals Monitoring.** When sewage sludge is applied, the accumulation of potential pollutants (including arsenic, cadmium, copper, lead, mercury, selenium, and zinc) in the soil shall be monitored in accordance with the US Code, Reference 40 CFR, Parts 403 and 503, and/or any applicable state and local laws or regulations.

**Additional Criteria to Minimize Agricultural Non-point Source Pollution of Surface and Ground Water Resources**

In areas with an identified or designated nutrient-related water quality impairment, an assessment shall be completed of the potential for nitrogen and/or phosphorus transport from the field. The Leaching Index (LI) and/or Phosphorus Index (PI), or other recognized assessment tools, may be used to make these assessments. The results of these assessments and recommendations shall be discussed with the producer and included in the plan.

Plans developed to minimize agricultural nonpoint source pollution of surface or ground water resources shall include practices and/or management activities that can reduce the risk of nitrogen or phosphorus movement from the field.

**Additional Criteria to Protect Air Quality by Reducing Nitrogen and/or Particulate Emissions to the Atmosphere**

Incorporate surface applications of solid forms of manure or some commercial fertilizer nitrogen formulations (i.e., Urea) into the soil within 24 hours of application.

When applying liquid forms of manure with irrigation equipment select application conditions when there is high humidity, little/no wind blowing, a forth coming rainfall event, and/or other conditions that will minimize volatilization losses into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan.

Handle and apply poultry litter or other dry types of animal manures when weather conditions are calm and there is less potential for blowing and emission of particulates into the atmosphere. The basis for applying manure under these conditions shall be documented in the nutrient management plan.

**Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil**

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties or biological condition. Use of nutrient sources with high salt content will be minimized unless provisions are used to leach salts below the crop root zone.

Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

**CONSIDERATIONS**

Excessive levels of some nutrients can cause induced deficiencies of other nutrients.

Consider additional practices such as Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strips (393), Irrigation Water Management (449),

Riparian Forest Buffer (391A), Conservation Crop Rotation (328), Cover and Green Manure (340), and Residue Management (329A, 329B, or 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms and to protect or improve water and air quality.

Use of cover crops whenever possible to utilize and recycle residual nitrogen.

Consider application methods and timing that reduce the risk of nutrients being transported to ground and surface waters, or into the atmosphere. Suggestions include:

- split applications of nitrogen to provide nutrients at the times of maximum crop utilization,
- avoiding winter nutrient application for spring seeded crops,
- band applications of phosphorus near the seed row,
- applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques, and/or
- immediate incorporation of land applied manures or organic by-products,
- delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

The potential problems from odors associated with the land application of animal manures, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manures. Volatilization losses can become significant, if manure is not immediately incorporated into the soil after application.

The potential to affect National Register listed or eligible cultural resources.

Consider using soil test information no older than one year when developing new plans,

particularly if animal manures are to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: Soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test (PSNT), Pre-Plant Soil Nitrate Test (PPSN) or soil surface sampling for phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content, to enhance the producer's ability to manage manure effectively.

Using products or materials (e.g., nitrification inhibitors) that slow the conversion of nitrogen in manure or fertilizer into forms that move rapidly in the soil or into the atmosphere, and that reduce the potential for losses into water or air.

When applying manure with irrigation equipment, modification of the equipment can reduce the potential for volatilization of nitrogen from the time the manure leaves the application equipment until it reaches the surface of the soil (e.g., drop down tubes for center pivots). N volatilization from manure in a surface irrigation system will be reduced when applied under a crop canopy.

Consider the combined effects of nutrient application methods and other tillage operations on greenhouse gas emissions (e.g., nitrous oxide N<sub>2</sub>O, carbon dioxide CO<sub>2</sub>), and potential for carbon sequestration.

## PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan:

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, recordkeeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- the soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation,
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and
- the potential for soil phosphorus drawdown from the production and harvesting of crops.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements or producer goals.

In addition to the requirements described above, plans for nutrient management shall also include:

- discussion about the relationship between nitrogen and phosphorus transport and water quality impairment. The discussion about nitrogen should include information about nitrogen leaching into shallow ground water and potential health impacts. The discussion about phosphorus should include information about phosphorus

accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.

- discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment.
- a statement that the plan was developed based on the requirements of the current standard and any applicable federal, state, or local regulations or policies; and that changes in any of these requirements may necessitate a revision of the plan.
- the basis for the decisions for applying liquid or solid forms of manure with the intent of reducing nitrogen or particulate emissions to the atmosphere.

## OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- periodic plan review to determine if adjustments or modifications to the plan are needed. As a minimum, plans will be reviewed and revised with each soil test cycle.
- protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage.
- calibration of application equipment to ensure uniform distribution of material at planned rates.
- documentation of the actual rate at which nutrients were applied. When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.
- Maintaining records to document plan implementation. As applicable, records include:

- soil test results and recommendations for nutrient application,
- quantities, analyses and sources of nutrients applied,
- dates and method of nutrient applications,
- weather conditions at the time of application and time until a rainfall event occurred after application (applicable only to situations when air quality issues are being addressed in the plan),
- crops planted, planting and harvest dates, yields, and crop residues removed,
- results of water, plant, and organic by-product analyses, and
- dates of review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for five years; or for a period longer than five years if required

by other federal, state, or local ordinances, or program or contract requirements.

Workers should be protected from and avoid unnecessary contact with chemical fertilizers and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.